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ABSTRACT

The Stanford Achievement Test (SAT) was administered to 11,114 eighth grade students during fall 1984. This two-section report presents findings of the SAT's three mathematics subtests. These subtests measured achievement relative to mathematics concepts (number, notation, operations, and geometry and measurement), computation, and applications (story-problem items involving cost sharing, selection of an appropriate solution sentence, converting units, computation of measures, reading and interpreting graphs and charts, and others). Section I, an overview, discusses the purpose of the test, the background of the test administration, and the approach for program analysis; a general summmary of performance is included. Section II provides an overall analysis and an analysis of each subtest relative to task requirement, student performance in Hawaii compared to national performance, implications, and recommendations. Supporting documentation (including SAT objectives correlated with learner objective or performance expectation) is included in appendices. The statewide summary of group stanine results indicates that eighth grade students in Hawaii performed slightly better than the national norm population with 78 percent scoring in the average and above average ranges. This is 1 percent higher than the national norm of 77 percent. (JN)

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MATHEMATICS PROGRAM ANALYSIS OF GRADE 8 STANFORD ACHIEVEMENT TEST, ADVANCED

Fall 1984 Administration

SE 045 816

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FOREWORD

As part of the Department's competency-based thrust, the analysis of test results is being conducted and reported. Performance data from tests and other sources are critical in the educational process and should be used to assist students, improve instruction, and upgrade programs. The efforts to date by teachers, principals and specialists are making significant impact on the achievement of students as indicated by the test results.

Although recent test results indicate overall improvement statewide, it is hoped that each level within the Department will continue to conduct review and analysis of formal data to determine student needs and related intervention activities. The momentum for positive change has begun and should be maintained, if not accelerated, as we work together to provide a solid foundation for all subsequent learning.

Francis M. Hatanaka

Francis M. Hatanaka, Superintendent

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OVERVIEW

A. Purpose

The purposes of this report are:

1. To provide information on the effectiveness of the mathematics program in the intermediate school, including identification of deficiency areas which require attention and the implications and recommendations for improving instruction towards the goals and objectives of the Foundation Program and Mathematics Education.

2. To provide a model for subsequent district and school analyses.

It is expected that state, district and school level improvement efforts will be directed at the identified deficiency areas.

B. Background of the Test Administration

The Stanford Achievement Test (SAT) has been administered since the mid-1970s to students of grades 2, 4, 6, 8, and 10 as a means of assessing and analyzing student performance in planning program improvement. For the purpose of this report, the data analysis and recommendations for improvement will be restricted to the 11,114 students of grade 8 who were tested during the Fall of 1984.

C. Approach for Program Analysis

The following framework guided the program planner for mathematics in the analysis process. With minor modification or changes in focus, the framework may be used by schools or teachers in the assessment of test results for use in instructional planning and delivery.

1. How well does the test measure the program efforts? (Curriculum Validity)

   a. How well does the subtest content (items) reflect the major program emphases?

   b. Are there test items that measure what is <u>not</u> taught until later in the school experience?

   c. Are there major emphases for grade 8 that are <u>not</u> measured by this test?

2. How are the students performing? (Student Achievement)

   a. How well are the students doing statewide?

   b. Are there variations among subtest areas?

   c. Are variations what would have been expected? If so, why?

   d. Are variations consistent across all seven districts?

Each subtest was analyzed according to task description, student performance, implications for program/instruction, and recommendations for improvement.

D. General Summary of Performance

The statewide summary of group stanine results indicates that eighth grade students in Hawaii performed slightly better than the national norm population with 78% scoring in the average and above average ranges. This is 1% higher than the national norm (77%).

	Below Average %	Average %	Above Average %
National	23	54	23
Hawaii's 8th Graders	22	55	23

GRADE 8 ADMINISTRATION

A. Overall Analysis

The Stanford Achievement Test (SAT), Advanced includes three subtests related to the area of mathematics: Mathematics Concepts, Mathematics Computation, and Mathematics Applications.

1. Curriculum Validity

The curriculum validity of the test is determined by comparing the test items with the Grade 8 Foundation Program Performance Expectations and grades 7-8 learner objectives listed in the Mathematics Program Guide. Although students are in the eighth grade, the test is administered early in the Fall and measures achievement up to the end of the seventh grade. Analysis of the SAT indicates that the test is moderately effective in assessing the attainment of the goals, objectives, and student performance expectations of the State Mathematics Program. There are twelve performance expectations for Foundation Program Objective I: Develop basic skills for learning and effective communication with others. The test does not measure two performance expectations relating to statistics and interpreting tables and schedules. In addition, two performance expectations are only partially measured.

The problem-solving process is a major goal of the mathematics program as well as of the Foundation Program (Foundation Program Objectives III: Develop decision-making and problem-solving skills). There are seven performance expectations of which the SAT addresses one.

Approximately 7% of the SAT items measure expectations which are not included in the State Mathematics Program or which may require performance at a level beyond Grade 8.

2. Student Performance

The results displayed in Figure 1 indicate that the eighth grade students in Hawaii scored better than the national norm population on the Mathematics Computation subtest. A comparison of the 1983 and 1984 results reveals the following:

1) There is no significant change in the number right and scaled scores for all three subtests. The scaled scores are based upon the raw scores. Scaled scores enable the interpreter to compare from grade to grade, battery to battery, and form to form, the scores within a single test area. Scaled scores are not comparable from one test area to another.

2) A review of the stanine distributions indicates:

a) Within the Mathematics Concepts subtest, the 1984 results are 1% higher than the 1983 results. The percent of students scoring in the average and above average ranges is the same as the percent of students in the nation (77%) scoring in the same ranges.

b) Within the Mathematics Computation subtest, the 1984 results are 1% lower than the 1983 results. The percent of students in Hawaii scoring in the average and above averge ranges (81%) is higher than the percent of students in the nation (77%) scoring in the same ranges.

c) Within the Mathematics Applications subtest, the 1984 results are 1% lower than the 1983 results. The percent of students in Hawaii scoring in the average and above average ranges (73%) is lower than the percent of students in the nation (77%) scoring in the same ranges.

	Mean Scores						Stanine Distribution								
	Number Right			Scaled Scores			Below 1 2 3			Average 4 5 6			Above 7 8 9		
Subtest	Norm	'83	'84	Norm	'83	'84	Norm	'83	'84	Norm	'83	'84	Norm	'83	'84
Concepts	19	18	18	187	183	183	23	24	23	54	54	56	23	22	21
Computation	25	27	26	185	186	185	23	18	19	54	54	54	23	28	27
Applications	23	22	22	184	180	180	23	26	27	54	52	52	23	22	21

Figure 1

3. Implications

Although eighth grade students perform better than the norm population of the test in the Computation subtest, there is a need to work towards improvement in all areas.

4. Recommendations

Analysis should be made of each of the subtests to identify those items students did not perform well on. Comparisons should be made of these items with the performance expectations and mathematics program objectives, reasons for student performance should be determined, and improvement strategies should be implemented where appropriate. Although the problem-solving process is not tested fully in the Applications subtest, a priority should be placed on the instructional delivery of the problem-solving process and development of logical thinking skills to improve overall mathematics performance.

B. Subtest Analysis

The following is an analysis of each subtest relative to the task requirement, student performance in Hawaii as compared to national performance, implications, and recommendations. The student performance comparison is made with respect to the mean p-values in each of the item-grouping areas. Each subtest is divided into four or five groups in which the test items are closely related. The p-value, which gives the percent of students answering the problem correctly is used to determine what students may need help with. A comparison of local p-values with those of the national norm is used in discussing the implications which are drawn from the relationship of performance expectations with the SAT objectives.

Further study within each of the item-group areas is made for those areas in which the local p-value is lower than the national p-value. Each item with a lower p-value is listed, but only those items considered significantly lower* are discussed in the section on implications. Thus, the sections on implications and recommendations will deal primarily with identifying areas for program improvement.

1. Mathematics Concepts

a. Description of Task

The subtest consists of 35 items which require the student to read each item and select an answer from four options. Item groupings are in four areas: 1) numbers, 2) notation, 3) operations, and 4) geometry and measurement.

b. Student Performance

Figure 2 below compares the local and national mean p-values in each item-grouping area. The results show that students in the State of Hawaii scored slightly lower in the areas of numbers and operations. A comparison between the 1983 and 1984 results indicates slight changes in three item grouping areas as shown below.

	Local %		National %	Difference	
	1983	1984		1983	1984
Numbers	55	54	56	-1	-2
Notation	59	60	59	-0-	+1
Operations	49	48	51	-2	-3
Geometry, Measurement	49	49	48	+1	+1

Figure 2

*Items with local p-values at least 4 percentage points lower than the national norm are considered significantly low.

Item analysis indicates that the test objectives where students scored lower were as follows:

1) Numbers

   a) Identifies common fraction which represents division problem (item 6*).

   b) Expresses fractional part of set as common fraction (item 9*).

   c) Selects an inequality statement which correctly compares a fraction and a whole number (item 12).

   d) Chooses opposite of a positive integer (item 22).

   e) Adds in modulo 7 (item 30*).

2) Notation

   a) Translates a given Arabic numeral into word form (item 2).

   b) Identifies base ten equivalent of a number written in base four (item 16).

   c) Selects the mixed number representation of a decimal fraction (item 24*).

3) Operations

   a) Chooses solution set of an inequality (items 5*, 8*).

   b) Identifies multiplicative identity (item 11).

   c) Chooses the number sentence which illustrates associative property of addition (item 15*).

   d) Identifies sign for quotient of a division problem involving two negative numbers (item 25*).

   e) Indicates change in one factor if dividend remains constant and other factor becomes less (item 29*).

4) Geometry and Measurement

   a) Selects a subset of a given set (item 10*).

   b) Choose the Venn diagram which shows the intersection of two sets (item 23).

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*Items with local p-values at least 4 percentage points lower than the national norm are considered significantly low.

Specific items in each of the above areas where students scored significantly lower were items 5, 6, 9-10, 15, 24, 25, 29, and 30. The p-values for all of these items except items 29 and 30 were also significantly lower in 1983.

c. Implications

Eighth grade students in Hawaii did not do as well as the norm group on specific items that require:

1) choosing the solution set of an inequality,

2) identifying the common fraction which represents a division problem,

3) expressing a fractional part of a set as a common fraction,

4) selecting a subset of a given set,

5) choosing the number sentence which illustrates the associative property of addition,

6) adding in modulo seven,

7) indicating the change in one factor if the dividend remains constant and the other factor becomes less,

8) selecting the mixed number representation of a decimal fraction, and

9) identifying the sign for the quotient of a division problem involving two negative numbers.

All of the above, except objectives 3 and 4 are related to performance expectations and mathematics program objectives that students should have met by the end of the eighth grade. Selecting a subset of a given set does not match any of the mathematics learner objectives and performance expectations of the Foundation Program. However, the item requiring the student to express a fractional part of a set as a common fraction is related to a fifth grade learner objective (expressing fractions in lowest terms). Consequently there is a need to improve student performance in this area.

d. Recommendations

Continue to pursue the performance expectations with more emphasis placed on related learner objectives that address concepts where p-values were significantly lower than the national norm. Special attention should be given to developing the concept of a fraction and in particular, expressing a fractional part of a set as a common fraction, which is an area students should have mastered by the end of the fifth grade.

2. Mathematics Computation

a. Description of Task

The subtest consists of 45 items. Items 1-19 consist of number sentences which must be completed by the appropriate symbol (>, <, or =).

Items 20-45 are computation algorithms, with five answer options including the NH (not here) option. Problems involve addition and subtraction of multi-digit numerals, multiplication with three-digit multipliers, division with one-digit and two-digit divisors, addition and multiplication of fractions and decimals, addition of numbers raised to a power, finding the least common denominator of three fractions, finding averages, estimating a quotient, finding percent of a given number, solving for a variable, and determining the solution set of an inequality.

Item groupings are in five areas: 1) knowledge of primary facts and solution of simple mathematical sentence, 2) addition and subtraction algorithms, 3) multiplication and division algorithms, 4) common fractions, and 5) other operational models.

b. Student Performance

Figure 3 below compares local and national p-values in the item groups. The results show that the students in Hawaii scored higher in two of the five item-grouping areas. These results are similar to those of the previous year, with slight decreases in three of the five areas.

	Local %		National %	Difference	
	1983	1984		1983	1984
Knowledge of primary facts and solution of simple mathematical sentence	62	62	62	-0-	-0-
Addition and subtraction algorithms	74	72	67	+7	+5
Multiplication and division algorithms	66	66	57	+9	+9
Common fractions	52	50	50	+2	-0-
Other operational models	48	47	43	+5	+4

Figure 3

Item analysis indicates that test objectives where students scored lower were as follows:

1) Knowledge of primary facts and solution of simple mathematical sentence

   a) Applies associative property of multiplication (items 1-2).

   b) Multiplies and subtracts and renames a fraction (item 9).

   c) Adds with positive and negative integers (item 12*, 19*).

   d) Renames common fractions which involve negative terms (item 14*).

   e) Simplifies two sums involving negative integers (item 16*).

   f) Renames exponential numerals and adds (item 17*).

   g) Applies distributive property of multiplication over addition (item 18).

2) Common fractions

   a) Finds least common denominator of three unit fractions (item 22).

   b) Adds two mixed numerals in which a common denominator must be found (item 25).

   c) Finds a common fraction of a whole number (item 32*).

3) Other operational models

   a) Finds average of two numbers, involving easy addition (item 36*).

   b) Finds a total when a part and its percent of the total are known (item 38*).

Specific items in each of the above areas where students scored significantly lower were items 12, 14, 16, 17, 19, 32, 36, and 38. The p-values for all of these items were also significantly lower in 1982.

c. Implications

Although overall student performance was higher than the national norm, eighth grade students of Hawaii did not do as well as the norm group on specific items that require:

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*Items with local p-values at least 4 percentage points lower than the national norm are considered significantly low.

1) adding with positive and negative integers,

2) renaming common fractions which involve negative terms,

3) simplifying two sums involving negative integers,

4) renaming exponential numerals and adding,

5) finding the average of two numbers, involving easy addition,

6) finding a total when a part and its percent of the total are known, and

7) finding a common fraction of a whole number.

Finding the average of two numbers involving easy addition is a mathematics objective students should have met by the end of the fifth grade. Finding a common fraction of a whole number is comparable to a sixth grade performance expectation. However, the remaining five objectives are expectations students should meet by the end of the eighth grade.

d. Recommendations

Continue to pursue the performance expectations with a focus on the instructional strategies related to the specific learner objectives that address finding averages and computing with integers, fractions and percents. Program improvement should include providing teachers with the instructional strategies to teach concepts and skills in these areas.

3. Mathematics Applications

a. Description of Task

The subtest consists of 40 story-problem items involving cost sharing; selection of an appropriate solution sentence; rate, scale, and percent; conversion from one unit to another; computation of measures; reading and interpretation of graphs and charts; probability and statistics. There are five answer options, not all containing the NH option. Item groupings are in five areas: 1) analysis and development of a solution design, selection of a solution sentence, and adequacy of data; 2) rate, scale, and percent; 3) measurement; 4) graph reading and interpretation; and 5) statistics, average, and probability.

b. Student Performance

The chart on the following page compares local and national mean p-values in the item-grouping areas. The results show that students in the State of Hawaii scored lower in all areas except in measurement and graph reading and interpretation. These results are very similar to those of the previous year.

	Local %		National %	Difference	
	1983	1984		1983	1984
Analysis and development of a solution design, selection of a solution sentence, and adequacy of data	66	66	68	-2	-2
Rate, scale, and percent	56	56	60	-4	-4
Measurement	44	44	44	-0-	-0-
Graph reading and interpretation	51	50	50	+1	-0-
Statistics, average, and probability	55	54	56	-1	-2

Figure 4

Item analysis indicates that almost all of the test objectives had lower p-values, except for those items requiring 1) determining correct change in a two-step sequence, 2) determining a specific percent, 3) calculating area of a shaded region of a square, 4) finding the volume of a rectangular solid, 5) matching an English unit of measure with a metric unit approximation, 6) finding and comparing area of a square and a parallelogram, 7) finding area of a rectangle, 8) finding the sum of six angles, 9) identifying finishing time when given starting and elapsed times, 10) using a line graph to make a comparison, or to find a total, 11) choosing a graph of a solution set, 12) finding rule of a mathematical sentence with two variables and choosing a solution set to match, and 13) translating a verbal problem into a mathematical sentence.

Items where p-values were significantly lower were:

1) Analysis and development of solution design, selection of solution sentence and adequacy of data

   a) Identifying extraneous data not needed in the solution (item 6).

   b) Recognizing that additional data is needed for solution (item 17).

   c) Choosing verbal expression which describes process of solving problem (item 31).

   d) Estimating ratio of two numbers greater than one thousand (item 36).

2) Rate, scale and percent

a) Determining a specific rate when one rate is expressed as an average (item 1).

b) Expressing a part of the total as a fraction (item 8).

c) Interpreting a map scale to determine relative distances (item 12).

d) Finding a total when a part and its fractional representation of the whole are known (item 13).

e) Expressing a part of the total as a fraction (item 23).

f) Converting a distance to a map scale (item 29).

3) Measurement

a) Converting standard measures of weight in order to divide (item 14).

b) Adding with negative numbers on a thermometer (item 25).

c) Adding two measurements expressed in metric units (item 35).

4) Graph reading and interpretation

a) Choosing graph of a solution set (item 9).

b) Using line graph to make a comparison (item 20).

5) Statistics, average and probability

a) Identifying probability of occurrence of a defined event (item 39).

c. Implications

All of the items above except items 14, 23, and 25 were also significantly lower in 1983. In addition all, except items 20 and 31 are related to performance expectations or learner objectives that students are expected to have met by the end of the eighth grade. Item 20 is related to a sixth grade performance expectation. Item 31 does not match any performance expectation, but requires the student to apply skills that should have been mastered by the end of the fourth grade.

d. Recommendations

Continue to pursue the performance expectations of the Mathematics Program. Reasons should be determined for students' low performance and work should begin towards improvement. Program improvement may include providing students with more experiences involving both systems of measure (metric and customary), determining ratio, and solving rate problems using problem-solving strategies. There are commercial programs which address problem-solving in consonance with the Mathematics Program Guide. Schools will need to determine if these programs can be used to meet students' needs.

The Mathematics Program Guide also provides direction in identifying problem-solving behaviors and strategies for teaching. Schools should investigate to see how these strategies may be used for teaching problem solving within their ongoing program. Schools should also look at the available in-service workshops which address this need, and encourage their teachers to participate.

Appendix A

Grade 8 SAT
Item Matches

CONCEPTS Item No.	Content	Learner Objective (LO) Performance Expectation (PE)	Grade PE/LO
1.	Identifies the numeral expressed in expanded notation.	Writes numerals in expanded and exponential notation.	7-8 LO
2.	Translates a given Arabic numeral into its word form.	Reads, writes (using words and symbols) and verbalizes mathematical ideas in order to communicate quantitative information.	7-8 LO
3.	Chooses the number which belongs in a given number series.	Recognizes patterns for a set of numbers.	7-8 LO
4.	Identifies the exponential notation for a given numeral.	Writes numerals in expanded and exponential notation.	7-8 LO
5.	Chooses the solution set of an inequality.	Uses algebraic techniques and describes their relationship to the properties of real numbers.	8 PE
6.	Identifies a common fraction which represents a division problem.	Recognizes fractions as indicated division.	7-8 LO
7.	Identifies a prime number.	Investigates the characteristics of prime and composite numbers and classifies numbers less than 50 as prime or composite (or neither).	5 LO
8.	Chooses the solution set of an inequality.	Uses algebraic techniques and describes their relationship to the properties of real numbers.	8 PE
9.	Expresses a fractional part of a set as a common fraction.	Uses whole numbers and commonly used fractions (e.g., $\frac{1}{4}$, $\frac{1}{2}$) to communicate physical quantities.	3 PE
		Investigates ways to express fractions in lowest terms.	5 LO
10.	Selects a subset of a given set.	No match.	
11.	Identifies the multiplicative identity.	Uses algebraic techniques and describes their relationship to the properties of real numbers.	8 PE
12.	Selects an inequality statement which correctly compares a fraction and a whole number.	Compares mixed numbers.	5 LO
		Compares two rational numbers and uses the appropriate symbol to denote the comparison (e.g., $>$, $<$, $=$, $\neq$).	7-8 LO
13.	Chooses the expanded notation representation of a specific digit of a given numeral.	Writes numerals in expanded and exponential notation.	7-8 LO

Item No.	Content	Learner Objective (LO) Performance Expectation (PE)	Grade PE/LO
14.	Indicates the English measurement unit equivalent to a given numeral.	No match.	
15.	Chooses the number sentence which illustrates the associative property of addition.	Generalizes properties of numbers.	7-8 LO
		Uses algebraic techniques and develops their relationsip to the properties of real numbers.	8 PE
16.	Identifies the base ten equivalent of a number written in base four.	Reviews the meaning of system of numeration and investigates other systems of numeration through comparison with the decimal system.	7-8 LO
17.	Rounds a number to the nearest whole number.	Rounds decimals to the nearest tenth, nearest whole number, nearest hundredths, or nearest thousandths.	5 LO
18.	Selects the standard fractional notation of a given decimal fraction.	Understands and uses the relationship between common fractions (simple and mixed) and decimal fractions.	7-8 LO
		Uses division to express a fraction as a decimal.	6 LO
19.	Selects a set consisting only of odd numbers.	Discovers special arrangements of objects for even and odd numbers.	2 LO
20.	Identifies a geometric figure from its description.	Uses correct terminology in describing the properties of geometric figures.	6 PE 8 PE
		Compares number of sides, angles, and diagonals of polygons.	5 LO
21.	Identifies the product of two decimal fractions.	Multiplies and divides decimals.	6 PE 8 PE
		Multiplies decimals.	5 LO
22.	Chooses the opposite of a positive integer.	Uses algebraic techniques to describe their relationships to the properties of real number.	8 PE
23.	Choose the Venn diagram which shows the intersection of two sets.	No match.	

Item No.	Content	Learner Objective (LO) Performance Expectation (PE)	Grade PE/LO
24.	Selects the mixed number representation of a decimal fraction.	Expresses fractions as decimals to hundredths.	5 LO
		Uses division to express a fraction as a decimal.	6 LO
		Understands and uses the relationship between common fractions (simple and mixed) and decimal fractions.	7-8 LO
25.	Identifies the sign for the quotient of a division problem involving two negative numbers.	Uses algebraic techniques and describes their relationship to the properties of real numbers.	8 PE
		Finds the sums, differences, products and quotients of integers.	7-8 LO
26.	Identifies a specified angle.	Estimates the measure of angles. Uses a protractor to draw and measure angles with reasonable accuracy.	7-8 LO
		Uses correct terminology in describing properties of geometric figures.	6 PE 8 PE
27.	Identifies the general formula for the perimeter of a square.	Computes measurements of various common plane and solid geometric figures.	8 PE
		Uses algebraic techniques and describes their relationship to the properties of real numbers.	8 PE
		Without the use of formula, finds the perimeter, areas, and volumes of geometric figures.	7-8 LO
		Uses formulas to find areas of rectangles and triangles.	7-8 LO
28.	Chooses the correct estimation of a quotient.	By rounding, estimates quotients.	6 LO
29.	Indicates the change in one factor if the dividend remains constant and the other factor becomes less.	Uses algebraic techniques and describes their relationship to the properties of real numbers.	8 PE
30.	Adds in modulo 7.	Reviews the meaning of system of numeration and investigates other systems of numeration through comparison with the decimal system.	7-8 LO

Item No.		Learner Objective (LO) Performance Expectataion (PE)	Grade PE/LO
31.	Distinguishes line segments from other geometric illustrations.	Classifies plane and solid geometric figures into various subsets using different specialized properties.	6 PE 8 PE
		Uses correct terminology in describing properties of geometric figures.	6 PE
32.	Identifies the true statement regarding the relationship between various geometric figures.	Explains relationships of the parts of a geometric figure and relationships among geometric figures.	8 PE
33.	Chooses the number sentence which describes a given operation.	Uses algebraic techniques and describes their relationship to the properties of real numbers.	8 PE
34.	Chooses the set of ordered pairs which is graphed.	Locates points on a grid for an ordered pair of numbers and connects points to draw a geometric figure.	5 LO
35.	Determines the probability of occurrence of a specific event.	Conducts experiments in order to understand the notion of chance.	7-8 LO
COMPUTATION			
1.	Applies the associative property of multiplication.	Compares two rational numbers and uses the appropriate symbol to denote the comparison.	7-8 LO
		Uses algebraic techniques and describes their relationship to the properties of real numbers.	8 PE
2.	Applies the associative property of multiplication.	Compares two rational numbers and uses the appropriate symbol to denote the comparison.	7-8 LO
		Uses algebraic techniques and describes their relationship to the properties of real numbers.	8 PE
3.	Applies the distributive property of multiplication over addition.	Compares two rational numbers and uses the appropriate symbol to denote the comparison.	7-8 LO
		Uses algebraic techniques and describes their relationship to the properties of real numbers.	8 PE
4.	Applies the associative property of multiplication.	Compares two rational numbers and uses the appropriate symbol to denote the comparison.	7-8 LO

Item No.	Content	Learner Objective (LO) Performance Expectation (PE)	Grade PE/LO
		Uses algebraic techniques and describes their relationship to the properties of real numbers.	8 PE
5.	Multiplies two digits and adds a carry fact.	Compares two rational numbers and uses the appropriate symbol to denote the comparison.	7-8 LO 7 PE/LO
		Uses algebraic techniques and describes their relationship to the properties of real numbers.	8 PE
6.	Renames exponential numerals and multiplies.	Explores the meaning of integral exponents.	7-8 LO
7.	Divides and obtains quotients with remainders.	Divides with 1-digit divisors having quotients 3 digits or less.	4 LO
8.	Divides and obtains quotients with remainders.	Divides with 1-digit divisors having quotients 3 digits or less.	4 LO
9.	Multiplies and subtracts and renames a fraction.	Computes multi-operational problems by applying the rule for the order of operation.	7-8 LO
10.	Recognizes that division is not distributed over subtraction.	Uses algebraic techniques and describes their relationship to the properties of real numbers.	8 PE
11.	Multiplies with positive and negative integers.	Adds, subtracts, multiplies and divides fractions and integers.	8 PE
12.	Adds with positive and negative integers.	Adds, subtracts, multiplies and divides fractions and integers.	8 PE
13.	Multiplies with positive and negative integers.	Adds, subtracts, multiplies and divides fractions and integers.	8 PE
14.	Renames common fractions which involve negative terms.	Adds, subtracts, multiplies and divides fractions, and integers.	8 PE
15.	Renames two fractions.	Orders fractions from least to greatest using " < " and " > ".	5 LO
16.	Simplifies two sums involving negative integers.	Adds, subtracts, multiplies and divides fractions and integers.	8 PE
17.	Renames exponential numerals and adds.	Explores the meaning of integral exponents.	8 LO
18.	Applies the distributive property of multiplication over addition.	Uses algebraic techniques and describes their relationship to the properties of real numbers.	8 PE

Item No.	Content	Learner Objective (LO) Performance Expectation (PE)	Grade PE/LO
19.	Adds with positive and negative integers.	Adds, subtracts, multiplies and divides fractions, and integers.	8 PE
20.	Subtracts a three-digit subtrahend from a four-digit minuend with renaming.	Adds and subtracts 3-digit numbers with regrouping.	3 PE
21.	Divides easy facts involving renaming, but no remainder.	Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE
22.	Finds the least common denominator of three unit fractions.	Searches for common multiples of two or more numbers.	5 LO
23.	Subtracts a five-digit subtrahend from a six-digit minuend in a problem which involves a zero in the minuend, renaming, and a disappearing left digit.	Adds and subtracts whole numbers.	6 PE
24.	Solves an addition problem involving an exponential numeral.	Explores the meaning of integral exponents.	7-8 LO
25.	Adds two mixed numerals in which a common denominator must be found.	Adds, subtracts, multiplies and divides fractions and integers.	8 PE
		Adds and subtracts commonly used fractions with unlike denominators.	6 PE
26.	Adds a broken column of three addends.	Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE
27.	Multiplies two three-digit numerals with a zero in the tens place of each numeral.	Uses the division algorithm in finding the quotient of all whole numbers.	6 LO
28.	Adds a broken column of four addends.	Adds and subtracts 3-digit numbers with regrouping.	3 PE
29.	Subtracts a five-digit subtrahend from a six-digit minuend in a problem which involves a zero in the minuend, renaming, and a disappearing left digit.	Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE
30.	Divides by a one-digit divisor and obtains a quotient with a zero in the ones place and a remainder.	Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE

Item No.	Content	Learner Objective (LO) Performance Expectation (PE)	Grade PE/LO
31.	Locates the decimal point of a whole number multiplied by a decimal fraction.	Multiplies and divides decimals.	6 PE
32.	Finds a common fraction of a whole number.	Multiplies and divdes mixed and common fractions.	6 PE
33.	Divides by a two-digit divisor and obtains a quotient with a zero in the tens place, but no remainder.	Uses the division algorithm in finding the quotients of whole numbers.	6 LO
34.	Solves an addition problem involving exponential numerals.	Explores the meaning of integral exponents.	7-8 LO
35.	Finds a number for which the prime factorization is given.	Investigates multiples and factors of a number; and expresses a number as a multiple of some number, and expresses a number as a product of factors.	5 LO
36.	Finds the average of two numbers, involving easy addition	Finds averages.	5 LO
37.	Locates the decimal point in the quotient of two mixed decimal numerals.	Estimates before performing the basic operations (decimals).	6 LO
38.	Finds a total when a part and its percent of the total are known.	Solves ratio, proportion, and percent problems.	6 PE 8 PE
39.	Multiplies two common fractions.	Multiplies and divides mixed and common fractions.	6 PE
40.	Solves for the variable in a number sentence.	Uses algebraic techniques and describes their relationship to the properties of real numbers.	8 PE
41.	Divides a mixed numeral by a common fraction.	Multiplies and divides mixed and common fractions.	6 PE
42.	Locates the decimal point in the quotient of a mixed numeral and a decimal fraction.	Estimates before performing the basic operations (decimals).	6 LO
43.	Finds the greatest common factor of two numbers.	Investigates a variety of ways to determine least common multiples and common factors.	7-8 LO
44.	Finds a percent of a number.	Solves ratio, proportion, and percent problems.	6 PE 8 PE

Item No.	Content	Learner Objective (LO) Performance Expectation (PE)	Grade PE/LO
45.	Matches a number line graph with the set it represents.	Solves open sentences (equations and/or inequalities) by formal methods and graphs the solutions.	Alg. IA
APPLICATIONS			
1.	Determining a specific rate when one rate is expressed as an average.	Solves simple ratio, proportion, and percent problems.	6 PE 8 PE
2.	Dividing to determine the amount of each share.	Applies: Gr. 6 PE "Multiplies and divides decimals."	6 PE
3.	Adding and multiplying in a multi-step sequence.	Does two-step problem by 4th grade. Applies grade 6 PE "Measures and computes measurements using the 4 basic operations," or adds and subtracts like-denominator fractions and commonly-used decimals.	6 PE
4.	Computing an average.	Finds averages.	5 LO
5.	Translating a verbal problem into a mathematical sentence.	Uses algebraic techniques and describes their relationship to the properties of real numbers.	8 PE
6.	Identifying extraneous data not needed in the problem solution.	Asks appropriate questions to identify and clarify a problem and determines the information needed to solve the problem.	FPO III 6 PE
		Raises questions related to a problem based on information gathered from various sources.	8 PE
7.	Determining correct change in a two-step sequence.	Does two-step problem by 4th grade. Applies grade 6 PE, "Adds and subtracts like-denominator fractions and commonly-used decimals."	6 PE
8.	Expressing a part of the total as a fraction.	Solves simple ratio, proportion and percent problems, and	6 PE 8 PE
		Uses ratios to compare quantities and measurements of objects.	6 PE 8 PE
9.	Choosing a graph of a solution set.	Uses algebraic techniques and describes their relationship to the properties of the real numbers.	8 PE
		Graphs and analyzes polynomial, rational, exponential, and logarithmic functions, and solves corresponding equations and inequalities.	10 PE

Item No.	Content	Learner Objective (LO) Performance Expectation (PE)	Grade PE/LO
10.	Determining a specific rate.	Solves simple ratio, proportion, and percent problems.	6 PE 8 PE
11.	Calculating the area of a shaded region of a square.	Computes measurements of various common plane and solid geometric figures.	8 PE
12.	Interpreting a map scale to determine relative distances.	Solves ratio, proportion, and percent problems.	6 PE 8 PE
13.	Finding a total when a part and its fractional representation of the whole are known.	Uses algebraic techniques and describes their relationship to the properties of real numbers.	8 PE
14.	Converting standard measures of weight in order to divide.	Computes measurements using the four basic operations and converts among units.	8 PE
15.	Determining correct change in a two-step sequence.	Does two-step problems by 4th grade. Applies grade 6 PE "Adds and subtracts like-denominator fractions and commonly-used decimals."	6 PE
16.	Translating a verbal problem into a mathematical sentence.	Uses algebraic techniques and describes their relationship to the properties of the real numbers.	8 PE
17.	Recognizing that additional data is needed for the problem solution.	Asks appropriate questions to identify and clarify a problem and determines the information needed to solve the problem.	FPO III 6 PE
		Raises questions related to a problem based on information gathered from various sources.	8 PE
18.	Using a line graph to make a comparison.	Makes graphs and tables to display compare measurement data.	6 PE
19.	Using a line graph to find a total.	Makes graphs and tables to display compare measurement data.	6 PE
20.	Using a line graph to make a comparison.	Makes graphs and tables to display compare measurement data.	6 PE
21.	Choosing a graph of a solution set.	Uses algebraic techniques and describes their relationship to the properties of the real numbers.	8 PE
		Graphs and analyzes polynomial, rational, exponentials, and logarithmic functions, and solves corresponding equations and inequalities.	10 PE

Item No.	Content	Learner Objective (LO) Performance Expectation (PE)	Grade PE/LO
22.	Determining a specific percent.	Solves simple ratio, proportion, and percent problems.	6 PE 8 PE
23.	Expressing a part of the total as a fraction.	Uses ratios to compare quantities, and measurements of objects.	6 PE 8 PE
		Solves simple ratio, proportion, and percent problems.	6 PE 8 PE
24.	Finding the remainder when a fraction of the total has been identified.	Solves ratio, proportion, and percent problems.	6 PE 8 PE
25.	Adding with negative numbers on a thermometer.	Adds, subtracts, multiplies, and divides fractions and integers.	8 PE
26.	Finding the volume of a rectangular solid.	Computes measurements of various common plane and solid geometric figures.	8 PE
27.	Translating a verbal problem into a mathematical sentence.	Uses algebraic techniques and describes their relationship to the properties of real numbers.	8 PE
28.	Determining a specific percent.	Solves simple ratio, proportion and percent problems.	6 PE 8 PE
29.	Converting a distance to a map scale.	Solves ratio, proportion and percent problems.	6 PE 8 PE
30.	Matching an English unit of measure with a metric unit approximation.	No match (similar to grade 5 LO "Locates distances and/or objects in the environment that have lengths about kilometer, a meter, a decimeter, and a centimeter).	
31.	Choosing the verbal expression which describes the process of solving the problem.	No match. Applies grade 2 LO "Discovers answers for □ in sentences such as 5 + □ = 7 using concrete materials and grade 4 LO "Adds and subtracts two or more decimals expressed in tenths and hundredths."	
32.	Identifying the probability of occurrence of a defined event.	Conducts experiments in order to understand the notion of chance.	7-8 LO
33.	Finding and comparing the area of a square and a parallelogram.	Computes measurements of various common plane and solid geometric figures.	8 PE
34.	Finding the area of a rectangle.	Computes measurements of various common plane and solid geometric figures.	8 PE

Item No.	Content	Learner Objective (LO) Performance Expectation (PE)	Grade PE/LO
35.	Adding two measurements expressed in metric units.	Computes measurements using the four basic operations and converts among units.	8 PE
36.	Estimating the ratio of two numbers greater than one thousand.	Uses ratios to compare quantities and measurements of objects.	6 PE 8 PE
		Estimates measurements and does arithmetic mentally.	3 PE
37.	Finding the sum of six angles.	Uses concepts relating to triangles such as: sum of the measures of the angles of a triangle is 180^{o}. (Core Geometry)	9-12 LO
38.	Identifying the finishing time when given the starting and elapsed times.	Computes measurements using the four basic operations and converts among units.	8 PE
39.	Identifying the probability of occurrence of a defined event.	Conducts experiments in order to understand the notion of chance.	7-8 LO
40.	Finding the rule (function) of a mathematical sentence with two variables and choosing a solution set to match.	Uses algebraic techniques and describes their relationship to the properties of real numbers.	8 PE
		Makes, reads and interprets tables and commonly used schedules.	6 PE

Appendix B

Items Not Matched to Grade 8 PEs
and Grades 7-8 Learner Objectives

Concepts	Item #	Description	Grade PE/LO
	7	Identifies a prime number.	5 LO
	9	Expresses a fractional part of a set as a common fraction.	3 PE
	10	Selects a subset of a given set.	--
	14	Indicates the English measurement unit equivalent to a given numeral.	--
	17	Rounds a number to the nearest whole number.	5 LO
	19	Selects a set consisting only of odd numbers.	2 LO
	23	Choose the Venn diagram which shows the intersection of two sets.	--
	28	Chooses the correct estimation of a quotient.	6 LO
	34	Chooses the set of ordered pairs which is graphed.	5 LO
Computation			
	7	Divides and obtains quotients with remainders.	4 LO
	8	Divides and obtains quotients with remainders.	4 LO
	15	Renames two fractions.	5 LO
	20	Subtracts a three-digit subtrahend from a four-digit minuend with renaming.	3 PE
	21	Divides easy facts involving renaming, but no remainder.	6 PE
	22	Finds the least common denominator of three unit fractions.	5 LO
	23	Subtracts a five-digit subtrahend from a six-digit minuend in a problem which involves a zero in the minuend, renaming, and a disappearing left digit.	6 PE
	26	Adds a broken column of three addends.	6 PE
	27	Multiplies two three-digit numerals with a zero in the tens place of each numeral.	6 LO
	28	Adds a broken column of four addends.	3 PE

29	Subtracts a five-digit subtrahend from a six-digit minuend in a problem which involves a zero in the minuend, renaming, and a disappearing left digit.	6 PE
30	Divides by a one-digit divisor and obtains a quotient with a zero in the ones place and a remainder.	6 PE
31	Locates the decimal point of a whole number multiplied by a decimal fraction.	6 PE
32	Finds a common fraction of a whole number.	6 PE
33	Divides by a two-digit divisor and obtains a quotient with a zero in the tens place, but no remainder.	6 LO
35	Finds a number for which the prime factorization is given.	5 LO
36	Finds the average of two numbers, involving easy addition.	5 LO
37	Locates the decimal point in the quotient of two mixed decimal numerals.	6 LO
39	Multiplies two common fractions.	6 PE
41	Divides a mixed numeral by a common fraction.	6 PE
42	Locates the decimal point in the quotient of a mixed numeral and a decimal fraction.	6 LO
45	Matches a number line graph with the set it represents.	Algebra IA

Applications

1	Determining a specific rate when one rate is expressed as an average.	6 PE
2	Dividing to determine the amount of each share.	6 PE
3	Adding and multiplying in a multi-step sequence.	6 PE
4	Computing an average.	5 LO
6	Identifying extraneous data not needed in the problem solution.	FPO III 6 PE
7	Determining correct change in a two-step sequence.	6 PE
8	Expressing a part of the total as a fraction.	6 PE
10	Determining a specific rate.	6 PE
15	Determining correct change in a two-step sequence.	6 PE

17	Recognizing that additional data is needed for the problem solution.	FPO III 6 PE
18	Using a line graph to make a comparison.	6 PE
19	Using a line graph to find a total.	6 PE
20	Using a line graph to make a comparison.	6 PE
22	Determining a specific percent.	6 PE
23	Expressing a part of the total as a fraction.	6 PE
28	Determining a specific percent.	6 PE
30	Matching an English unit of measure with a metric unit approximation.	--
31	Choosing the verbal expression which describes the process of solving the problem.	--
36	Estimating the ratio of two numbers greater than one thousand.	6 PE
37	Finding the sum of six angles.	9-12 LO

Appendix C

Grade 8 PE's Not Addressed

Performance Expectation	Comments
Adds, subtracts, multiplies, and divides decimals.	Partial match by one item.
Adds, subtracts, multiplies, and divides fractions and integers.	Partial match.
Describes and explains possible uses and misuses of basic statistical measurements.	No match.
Classifies plane and solid geometric figures into various subsets using different specialized properties.	Partial match by one item.
Uses correct terminology in describing the properties of geometric figures.	Match by two items.
Explains relationships of the parts of a geometric figure and relationships among geometric figures.	Match by one item.
Makes, reads, and interprets tables and commonly used schedules (e.g., class and bus schedules).	No match.